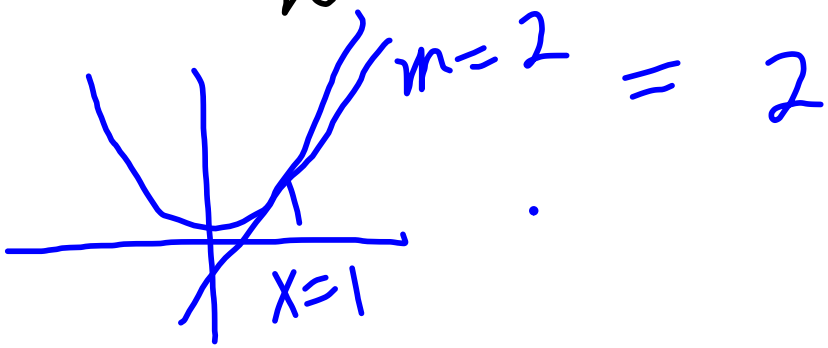
3.3 differentiation rules (short cuts for derivatives)

$f(x) = x^2 \qquad f'(1) = ?$

$$\lim_{h\to 0} \frac{f(1+h)-f(1)}{h} = \lim_{h\to 0} \frac{(1+h)^2 - 1}{h}$$

$$\lim_{h\to 0} \frac{1+2h+h^2-1}{h} = \lim_{h\to 0} \frac{h(2+h)}{h}$$

$$= 2$$



$f(x)=x^2$ $f'(a)=?$ $f'(x)=?$

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}=\lim_{h\to 0}\frac{(x+h)^2-x^2}{h}$$

$$\lim_{h\to 0}\frac{x^2+2xh+h^2-x^2}{h}$$

$$\lim_{h\to 0}\frac{h(2x+h)}{h}=2x$$

power rule for derivatives

$$f'(x^n) = \frac{d}{dx} x^n = n x^{n-1}$$

take the derivative

proof $\quad f(x) = x^n$

$$\lim_{h \to 0} \frac{(x+h)^n - x^n}{h}$$

$$\frac{x^n + nx^{n-1} \cdot h + \frac{n(n-1)}{2} x^{n-2} h^2 + \dots + h^n - x^n}{h}$$

$$\lim_{h \to 0} \frac{h\left(nx^{n-1} + \frac{n(n-1)}{2} x^{n-2} h + \dots + h^{n-1}\right)}{h}$$

$\to 0 \quad \to 0 \quad \to 0$

$$\frac{d}{dx} x^9 = 9x^8$$

$$\frac{d}{dx} c \cdot x^n = n \cdot c x^{n-1}$$

$$\frac{d}{dx} 3x^4 - x^2 + 2x =$$

$$12x^3 - 2x + 2$$

sum/diff rule

$$\frac{d}{dx}(3x^4+1) = 12x^3+0$$

$$= 12x^3$$

$$\frac{d}{dx}\,k = 0$$

der of a constant $= 0$

find eqn of tan & normal lines to $y = x^5 - 2x + 1$

at $x=1$ $y=0$ slope $y'(1)$

$y' = 5x^4 - 2 \Big|_{x=1} = 3$

tan line: $y = 3(x-1) - 0$

normal $y = -\frac{1}{3}(x-1) - 0$